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EXAMINER	
GARDNER, SHANNON M	
ART UNIT	**PAPER NUMBER**
1795	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/806,710	BIANCHI, MAURICE PETER	
	Examiner	**Art Unit**	
	Shannon Gardner	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _14 August 2008_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1,2,4-16 and 20-25_ is/are pending in the application.

4a) Of the above claim(s) _23 and 24_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1,2,4-16,20-22 and 25_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Remarks

Applicant has cancelled claims 3, 6, 17-19, and 22-23. New claim 24 has been added. Currently claims 1-2, 4-5, 7-16, 19-21, and 24 are pending in the application and are considered on their merits below. The claims have been renumbered as discussed below.

Response to Amendment

Applicant's amendment of 8/14/2008 does not render the application allowable.

Status of Objections and Rejections

All rejections from the previous office action are withdrawn in view of Applicant's amendment. New grounds of rejection are necessitated by amendments.

Claim Objections

1. The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Misnumbered claims 19-24 been renumbered 20-25.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 20-22are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 20 has been amended to include the negative limitation of "without taking any measures to correct for lattice mismatch". This is not supported by the Specification. Further, paragraph [0019] of the Specification discuses measures to take to correct for lattice mismatch.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-2, 4-5, 7-12, 15-16, 20 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bour (EP 977,279) in view of Wu et al. ("Superior radiation resistance of InGaN alloys: Full solar spectrum photovoltaic material system", Journal of Applied Physics, volume 94, Issue 10, November 15, 2003) and Schetzina (US 5,679,965).

As to claim 1, Bour is directed to a multi-junction solar cell assembly comprising (Figure 5; column 7, lines 32-36):

- a transparent substrate (405);

- a transparent conductive coating (TCC) (410) formed on the transparent substrate, the TCC comprising gallium nitride to provide a defect-free surface for growing an InGaN solar cell (column 7, lines 37-42);
- a plurality of gallium indium nitride junction layers grown successively on the TCC (437) (column 8, lines 16-19);
- a metallization layer (460) formed on the indium nitride junction layer (450, 440, 435).

It is the Examiner's position that as the transparent substrate taught by Bour can be of sapphire and the TCC coating is the same as the material of the instant claim, that the substrate and coating will provide a defect-free surface for growing the InGaN solar cell.

Bour further teaches group III-V nitrides that may be formed from an indium nitride junction layer (440) formed on the plurality of gallium indium nitride junction layers/quantum well active region (437) between the metallization layer (460) and the plurality of gallium indium nitride junction layers (435) (column 8, lines 35-39). Bour is silent as to the use of indium nitride junction layer formed on the plurality of gallium indium nitride junction layer and wherein each successive gallium indium nitride junction laver has a thickness greater than a thickness of the immediately preceding gallium indium nitride junction layer, each successive gallium indium nitride junction layer being directly adjacent the immediately preceding gallium indium nitride junction layer.

However, Wu et al. discloses a photovoltaic material for multi-junction cells (column 1, paragraph 1, page 6477) and further discloses solar cells fabricate tunnel

junctions out of p-type InN and InGaN (column1, last paragraph, page 6478) and (column 2, first paragraph, page 6478). Wu et al. teaches that InN has an energy band gap of 0.7eV and the band gap of InGaN alloys can be varied continuously from 0.7 to 3.4eV (paragraph 2 on page p.6477). Wu et al. further explains that this extends the range of the energy gaps of group III-nitride alloys from the deep ultraviolet to the practically very important near infrared spectral region and this spectral range provides an almost perfect fit to the solar spectrum, offering an unique opportunity to design multi-junction solar cell using a single ternary alloy system (paragraph 2 on page p.6477).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to employ InN and InGaN layer in multi-junction solar cell as taught by Wu et al. to the multi-junction solar cell of Bour in order to have a material with an energy band gap that offers a perfect fit to the solar spectrum and offering an unique opportunity to design multi-junction solar cell using a single ternary alloy system. Wu et al. in view of Bour fails to disclose wherein each successive gallium indium nitride junction laver has a thickness greater than a thickness of the immediately preceding gallium indium nitride junction layer, each successive gallium indium nitride junction layer being directly adjacent the immediately preceding gallium indium nitride junction layer.

Schetzina discloses a multiple quantum well semiconductor material composed of GaN layers (col.1; lines: 28-39) and further discloses wherein the multiple quantum *wells* has increasing thickness (emphasis on wells meaning more than one well/layer)

and operates as a “pseudo-graded” layer to eliminate the band offset between the cladding layers and GaN (col. 14; lines: 67 - col. 15; lines: 1-5).

Therefore, it would have been obvious to one skilled in the art at the time of the invention to apply the graded (increasing thickness) of the layers MQW of Schetzina to the semiconductor device of modified Bour, in order to eliminate the band offset between the cladding layers and GaN.

With respect to claim 2, Bour discloses a multi-junction solar cell assembly in accordance with claim 1, wherein the transparent substrate is sapphire (405) as shown in Figure 5 (col.7; lines: 32-36).

With respect to claim 4, Bour discloses a multi-junction solar cell assembly in accordance with claim 1, further comprising a gallium nitride junction layer (430) (col.8; lines: 32-34) between the transparent conductive coating (420) and the plurality of gallium Indium nitride junction layers/quantum well active region (437) (col.8; lines; 7-10).

As to claim 25, Bour is directed to a semiconductor structure comprising:

- a sapphire cover (405) (paragraph [0033]);
- a GaN transparent conductive coating (TCC) as a front collector (410), the GaN TCC formed on the sapphire cover (paragraph [0034]); and
- a plurality of InGaN junction layer/quantum well active region (437);
- wherein the GaN TCC provides a defect-free surface upon which the InGaN is grown.

It is the Examiner's position that because the materials taught for the device in Bour are the same as the materials of the instant claim, that the device of Bour will provide for a defect free surface upon which the InGaN can be grown.

Bour is not specific as to the use of his device as a solar cell assembly, though the reference discloses it as a semiconductor structure.

However, it is known in the art to create multi-junction solar cell out of p-type InN and InGaN as taught by Wu et al (pp 6477, column 1, 1st paragraph; pp 6478, column 1, last paragraph) to support a good fit to the solar spectrum based on the energy gaps of the materials used.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the device of Bour in a solar cell assembly as taught by Wu to support a nearly perfect fit to the solar spectrum based on the material energy gaps.

Regarding claim 5, modified Bour discloses a solar cell assembly wherein the solar cell includes a plurality of gallium indium nitride junction layers has a thickness of 1.0 microns (col.8; lines: 15-16).

In regard to claim 7, modified Bour discloses a solar cell assembly wherein each layer of the plurality of gallium indium nitride junction layers has a gallium content of about 70 wt% and an indium content of 30 wt% (col.3; lines: 9-14).

With respect to claim 8, modified Bour discloses a solar cell assembly wherein each successive layer of the plurality of gallium indium nitride junction layers has a gallium content less than the immediately preceding layer of the plurality of gallium

indium nitride junction layers (437) and an indium content greater than the immediately preceding layer of the plurality of gallium indium nitride junction layers; as shown in Figure 5 and the group III-V nitrides may be formed from an gallium indium nitride junction layer (440, 450, 430) (col.8; lines: 35-39) formed on the plurality of gallium indium nitride junction layers/quantum well active region (437) between the metallization layer (460) and the plurality of gallium indium nitride junction layers (435).

In regard to claim 9, modified Bour discloses a solar cell assembly wherein each layer of the plurality of gallium indium nitride junction layers has a band gap of 2.7eV (col.3; lines: 5-7).

With respect to claim 10, modified Bour discloses a solar cell assembly wherein each successive layer of the plurality of gallium indium nitride junction layers has a band gap less than the band gap of the immediately preceding layer of the plurality of gallium indium nitride junction layers (col.3; lines: 5-13). Bour teaches that GaN is 3.4eV and InN is 1.9eV, and in order to obtain the band gap around 2.7eV, the In content needs to be 50%. Thereby teaching that as the In content decreases or increases so does the band gap energy (col.3; lines: 19-25).

In regard to claim 11, modified Bour discloses a solar cell assembly wherein the transparent conductive coating comprises: a nucleation layer/buffer layer (310) formed on the sapphire cover; a lateral epitaxial overgrowth layer of gallium nitride formed nucleation layer (col.5; lines: 40-55); and a defect-free gallium nitride layer formed on the lateral epitaxial overgrowth layer (col.6; lines: 1-6).

With respect to claim 12, modified Bour discloses a solar cell assembly of claim

11 above, wherein the nucleation layer/buffer comprises: an aluminum nitride coating formed directly on the sapphire cover in intimate contact with the sapphire cover; and a seed layer of gallium nitride formed on the aluminum nitride coating (col.6; lines: 1-6).

In regard to claim 15, modified Bour discloses the transparent conductive coating comprises a gallium nitride layer (410) as shown in Figure 5 formed on the transparent substrate (col.5; lines: 40-55).

With respect to claim 16, modified Bour discloses a multi-junction solar cell assembly in accordance with claim 1, further comprising a metal current collector bus/electrode (460, 470 or 360,370) for receiving electrical power collected from the plurality of gallium indium nitride junction layers by the transparent conductive coating (col.6; lines: 55-58).

As to claim 20, Applicant is directed above for a full discussion of Bour in view of Wu and Shetzina. Modified Bour teaches a method of forming a multi-junction solar cell assembling comprising (see Bour Figure 5; column 7, lines 32-36):

- forming a transparent conductive coating including gallium nitride (410) on a sapphire cover (405) (column 7, lines 37-42); and
- growing a solar cell including a plurality of gallium indium nitride (437) junction layers on the transparent conductive coating (column 8, lines 16-19).

Bour fails to teach not taking measures to correct for lattice mismatch when growing the solar cell. However, the skilled artisan would understand that if gallium

nitride on a sapphire substrate allows for growth without lattice mismatch, then no measures need be taken.

3. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bour (EP 977,279) and Wu et al. (“Superior radiation resistance of InGaN alloys: Full solar spectrum photovoltaic material system", Journal of Applied Physics, volume 94, Issue 10, November 15, 2003) as applied to claim 25 above, and in further view of Schetzina (6,046,464).

In regard to claim 13, modified Bour discloses a solar cell assembly in accordance with claim 25 (Figure 5), but fails to discloses a solar cell assembly in accordance with claim 25, wherein the transparent conductive coating comprises: a plurality of alternating layers of gallium nitride and aluminum gallium nitride; and a plurality of quantum wells, each quantum well of the plurality of quantum wells formed at a corresponding interface between adjacent layers of gallium nitride and aluminum gallium nitride of the plurality of alternating layers of gallium nitride and aluminum gallium nitride.

Schetzina discloses multiple quantum well semiconductor material composed of InGaN and GaN layers as shown in Figures 9A-9C (col.10; lines: 36-40), and further discloses the transparent conductive coating comprises: a plurality of alternating layers of gallium nitride and aluminum gallium nitride (Figure 5); and a plurality of quantum wells (222b), each quantum well of the plurality of quantum wells formed at a corresponding interface between adjacent layers of gallium nitride and aluminum gallium nitride of the plurality of alternating layers of gallium nitride and aluminum

gallium nitride (Figure 6A). Schetzina teaches that the energy barrier (conduction band offset) between the conduction bands can be eliminated by adding an intermediate layers that are doped and continuously graded to maintain an equilibrium Fermi energy level throughout the structure, thereby providing for a suitable ohmic contact (col. 13; lines: 1-17 and col.5; lines: 48-55). It would have been obvious to one skilled in the art at the time of the invention to apply the alternating layers of GaN and AlGaN of Schetzina to the semiconductor device of modified Bour, in order to eliminate the conduction band offset thereby creating a better ohmic contact within the device.

With respect to claim 14, modified Bour discloses a solar cell assembly as applied to claim 13 above, wherein a first gallium indium nitride junction layer (InGaN) of the plurality of gallium indium nitride (InGaN) (435) junction layers is formed directly on a last gallium nitride layer (GaN) (430) (col.10; lines: 7-8). Bour fails to disclose the plurality of alternating layers of gallium nitride (GaN) and aluminum gallium nitride (AlGaN) in intimate contact with a plurality of InGaN layers.

Schetzina discloses multiple quantum well semiconductor material composed of InGaN and GaN layers as shown in Figures 9A-9C (col.10; lines: 36-40), and further discloses the plurality of alternating layers of gallium nitride and aluminum gallium nitride in intimate contact with the last gallium nitride layer of the plurality of alternating layers of gallium nitride and aluminum gallium nitride (Figure 5). Schetzina teaches that the energy barrier (conduction band offset) between the conduction bands of AlGaN and GaN in the multiple quantum wells (MQW) can be eliminated by adding an intermediate layers that are doped and continuously graded to maintain an equilibrium

Fermi energy level throughout the structure, thereby providing for a better ohmic contact (col. 13; lines: 1-17). It would have been obvious to one skilled in the art at the time of the invention to apply the alternating layers of GaN and AlGaN of Schetzina applied to the multiple quantum wells of InGaN of modified Bour, in order to eliminate the conduction band offset thereby creating a better ohmic contact within the device.

4. Claims 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bour (EP 977,279) as applied to claim 20, and further in view of Nishii et al. (2003/0205721) and Schetzina (US 5,679,965).

Regarding claim 21, Bour fails to disclose wherein the metallization layer is selected from a group that includes a layer of aluminum, a layer of chromium, and a layer of titanium and each successive gallium indium nitride junction laver has a thickness greater than a thickness of the immediately preceding gallium indium nitride junction layer, each successive gallium indium nitride junction layer being directly adjacent the immediately preceding gallium indium nitride junction layer.

Nishii et al. discloses semiconductor device composed of group III-nitride layers (paragraph 1), and further discloses the metallization layer including titanium pad electrode that is electrically connected to the device (paragraph 131). It would have been obvious to one of ordinary skill in the art at the time of the invention to employ titanium as the metallization layer as taught by Nishii et al. to the multi-junction solar cell of Bour in order to conduct electricity through the device.

With respect to claim 22, Bour discloses a method as applied to claim 20 above, further comprising a gallium nitride junction layer (430) (col.8; lines: 32-34) formed on

the transparent conductive coating (420) between the transparent conductive coating (420) and the plurality of gallium Indium nitride junction layers/quantum well active region (437) (col.8; lines; 7-10).

Response to Arguments

5. Applicant's arguments filed 8/14/2008 have been fully considered but they are not persuasive:

Applicant argues "the front collector of GaN TCC on a sapphire cover produces a defect-free surface for growing a multi-junction InGaN solar cell...This is an unexpected result, which is clearly recited in new claim 24" (pp 7-8 of Arguments).

The Examiner points out that arguments of counsel cannot take the place of evidence in the record. Statements regarding unexpected results must be supported by an appropriate affidavit or declaration (see MPEP 716.01 II).

Applicant argues that "Claim 19 has been amended... [and] should be allowed over the combination of Bour, Wu, and Schetzina" (pp 9 of Arguments).

The Examiner respectfully disagrees and points Applicant to the rejection of claim 19 in the action above for a full discussion of the references. Further, the Examiner notes that the limitation of “without taking any measures to correct for lattice mismatch” lacks written description in the Specification and is considered new matter.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shannon Gardner whose telephone number is (571)270-5270. The examiner can normally be reached on Monday to Thursday, 8am-5pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571.272.1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. G./
Examiner, Art Unit 1795

/Alexa D. Neckel/

Supervisory Patent Examiner, Art Unit 1795